Title: Perfect Patterns

Brief Overview:

This unit begins with non-numeric patterns. The students use linkage cubes, pattern blocks and hundred square paper on day 1 to create visual (non-numeric) patterns. Days 2 and 3 of the unit include increasing and decreasing numeric patterns. Students begin by identifying the pattern, extending it, then creating their own patterns in multiple ways using the same rule.

NCTM Content Standard/National Science Education Standard:

- Understanding patterns, relations and functions
- Recognize, describe, and extend patterns such as sequences of sounds and shapes or simple numeric patterns and translate from one representation to another.

Grade/Level:

Grades 3 (and extensions for grade 2)

Duration/Length:

This unit includes 3 lessons plus a summative assessment. The unit will take approximately 4 days, including the assessment. Teachers may need to spend additional days on individual lessons and topics based on student need.

Student Outcomes:

Students will be able to:

- Identify, describe, extend and create a variety of non-numeric patterns.
- Identify, describe, extend and create a variety of numeric patterns.

Materials and Resources:

Day 1

- Linkage cubes
- Pattern blocks
- Pencils
- Crayons
- Student math journals
- Venn diagram circles (these can be large plastic circles or drawn on chart paper- see teacher resource for sample)
- Chart/poster for examples and non-examples of growing patterns
- Large chart paper

- Teacher resources 1 through 8
- Student resources 1 through 4 (one copy for each child)

Day 2

- Index cards
- Markers
- Venn diagram circles
- Teacher resources 9 through 12
- Student resources 5 through 10 (one copy for each child)

Day 3

- Snacks (for modeling increasing and decreasing patterns)
- Index cards
- Teacher resources 13 and 14

Development/Procedures:

Lesson 1

Pre-assessment

Discuss the following questions with students:

- What is a pattern?
- What patterns do you see in everyday life?

Record answers on chart paper. Point out that the unit will focus on growing patterns (as opposed to repeating patterns). Introduce the vocabulary increasing and decreasing (see Teacher Resource 1). Make anecdotal records of students who have a lot of background knowledge and students who may need more support.

Launch

- Prepare the linkage cubes to show the patterns for each group (see Teacher Resource 2). If linkage cubes are not available, cut out the cube patterns from the teacher resource sheet and glue on index cards.
- Give each group of five students the cubes or cards, arranged in a pattern. Each student group should look at the pattern and determine what is happening (what is the change).
- Gather class together and each group will present their pattern to the class. Clarify any misconceptions. Ask other students to help group that may have misconceptions.

Teacher Facilitation

- Use the teacher sample (see Teacher Resource 3) to model how to determine what is happening in each pattern. Introduce and discuss the vocabulary: increasing, decreasing, growing pattern, pattern unit, term, extend- (see Teacher Resource 1).
- Model how to extend the patterns with the linkage cubes. Use the teacher answer key for extending the teacher patterns (Teacher Resource 4).

Student Application

- Each group will take their cubes or index cards, and extend the pattern (three more terms-see Teacher Resource 5 for answer key). Students can also write about the patterns they see in their math journals.
- Close the lesson by bringing the class back together and asking each student group to place their pattern in the appropriate spot in the Venn diagram (see Teacher Resource 6 for an example of how the patterns could be placed on the Venn diagram).
- Explain why nothing fits in the middle of the Venn diagram (the patterns are either increasing or decreasing-not both).

Embedded Assessment

Students will complete the day one check-up individually (Student Resource 1). See Teacher Resource 7 for the answer key. Use check-ups to make notes on student checklists (Teacher Resource 8).

Reteaching/Extension

- Take a pattern walk of the school. Help student find patterns such as: floor tiles, calendar, room numbers, bulletin board borders, number lines and other classroom visuals.
- Center ideas- use pattern blocks (Student Resource 2), square grid paper (Student Resource 3) or triangular paper (Student Resource 4). Have students create a visual increasing or decreasing pattern. Students can trade papers with their partners, identify the change in their partner's pattern and extend the pattern with the next three terms.
- Pull a small group of student who are struggling with the concept. Focus on determining what is changing in the pattern and using math vocabulary to describe the change.

Lesson 2

Pre-assessment

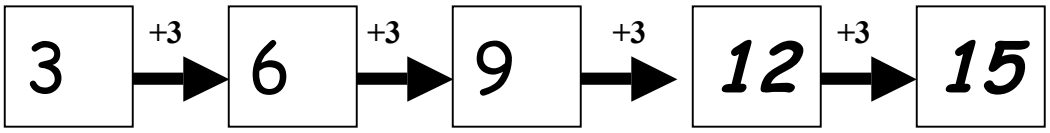
Students have been introduced to patterns from previous day. Ask students if they can identify any real life numeric patterns either in the classroom, in the school, or in the world around them. For example, the clock has a numeric pattern counting both by one and by fives. Write the student responses on the board, overhead, or chart paper.

Launch

- Place the students in groups of 5. Each student will get an index card with a number (see Teacher Resource 9 to make the cards). Every group will have cards that create a pattern. (Patterns include: counting up by twos, counting up by fives, counting back by threes, counting back by tens, and counting back by 25.) The groups will place themselves into a pattern either in increasing or decreasing order. To add a challenge you can ask the students to complete this activity without speaking.
- Once everyone has been placed in their groups or if there are students struggling with their placement, everyone will meet back to discuss their patterns and to introduce rules of patterns.
- The rule of the pattern is the format the pattern follows. When explaining the rule be sure to tell the students they must identify the starting point and what is happening to the pattern.
  Example: 2, 4, 6**, <u>8</u>, <u>10</u>, <u>12</u>** Rule: The pattern begins at 2 and increases by 2 or pattern starts at 2 and adds 2.

Teacher Facilitation

- Introduce the pattern graphic organizer below for the whole class lesson. Put the graphic organizer on chart paper for whole class use.
- Use the 100 chart and 200 charts to show the patterns and how students can count (Student Resource 5 and 6- one copy for each student).
- They may also use the 100 chart to help them to identify the rule and to extend the pattern.



Rule: Start at 3 and add or increase by 3.
Note: Students can write how each term is changing on the arrow.

Student Application

- Students will work with a partner to complete the worksheet for increasing and decreasing numeric patterns and extend them (Student Resource 7 and Teacher Resource 10 for the answer key).
- The students must also include a rule, and write how all of the terms are increasing.
- The students will complete one worksheet with numbers up to 100. Students who need a challenge can complete the worksheet with bigger numbers (Student Resource 8 and Teacher Resource 11 for answer key).

Embedded Assessment

- The students will individually create increasing numeric patterns and identify the rule in their patterns on an index card.
- The pattern will be written on one side of the pattern and the rule will be written on the other side.
- As students complete their patterns their index cards will be placed on a Venn diagram (see Teacher Resource 12).

Reteaching/Extension

- For those students who have not completely understood the lesson, use Student Resource 7 to review identifying the rule of the pattern without extending the pattern. Use the number line (Student Resource 9) to help students to identify the patterns.
- For those who have understood the lesson they can visit the following website for enrichment activities.
    - http://www.fi.edu/pieces/knox/skipcounting.htm
    - http://www.primarygames.com/patterns/start.htm
    - http://www.funbrain.com/cracker/index.html
- These websites are helpful in identifying both pictorial and number patterns. They will be asked to extend, complete, or identify missing terms in the patterns.

Lesson 3

Pre-Assessment/Launch

- Day 3 is a "wrap up" of the two previous days where students use the strategies and information that they've learned in order to apply it and problem solve.
- Tell all students to stand. Count the number of students in the class and record this number on the board/overhead.
- Ask 3 students to sit down. Record new total of standing students on the board/overhead.
- Repeat 3 times.
- Discuss what is happening to the total number of students each time three students are asked to sit down (rule).
- Ask students to predict what the next three terms will be.
- This activity can also be repeated with snacks (such as pretzels or candies) with the teacher taking away the same number of food pieces each time.

Teacher Facilitation

- Teacher will guide students in order to make generalizations about the patterns that they create.
- Write a pattern on the board that is decreasing by 2 leaving the last two terms blank (see Teacher Resource 13).
- Ask students to state the rule.

Student Application

- The students will pair up and work together on the pattern 10, 20, 30, 40, ____, _____ in their math journals.
- Tell the students to extend the pattern and identify the rule.
- Next the students must create two new patterns using the same rule or generalizations. **For patterns increasing and decreasing by ten the ones place in every term will be the same.**

Embedded Assessment

- Give half of the students the number 15 and the other half the number10.
- The students will independently create a pattern (starting with their number) on an index card that has a total of five terms and identify the rule.
- On the back of the index card the students will make some generalizations about that pattern. They can use their math journals if they need extra space.

Extension

- Tell the students to place the index card from the Embedded Assessment with the pattern face up in the Venn diagram (see Teacher Resource 14).

- Have students justify their answers.
- This extension is an excellent way for students to look at the numbers that they've created and to identify what their patterns have in common with other student's patterns.

Summative Assessment:

Administer the summative assessment individually (Student Resource 10). Allow students to use cubes, number lines, 100 charts, and any other manipulative they have been using throughout the unit. They can also use the kid-friendly rubric for BCR's (Student Resource 11). The teacher answer key and MSA rubric can be found in Teacher Resources 15 and 16.

Appendix A: Teacher Resources

Appendix B: Student Resources

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Vocabulary for Pattern Unit
(Adapted from Math Forum.com and Math Tool by Options)

Pattern- numbers or terms in a growing or repeating sequence
Example: 3, 6, 9, 12, 15 (increasing by 3 each time)

Repeating pattern- the repetition of the core
Example: a, b, c, a, b, c (abc is the core)

Increasing pattern- a pattern that grows with every term added
Example: 2, 4, 6, 8, 10

Decreasing pattern- a pattern that becomes smaller with every term added
Example: 50, 40, 30, 20, 10

Term (element) - The items or numbers in a pattern
Example: 5, 10, 15, 20 (each number is a term in the pattern)

Extend- continuing the pattern
Example: if you extend the pattern 2, 4, 6, 8, the next terms would be 10, 12, 14

Pattern Unit (core) - The base of the pattern (before it starts repeating)
Example: in the pattern a, b, c, a, b, c, the pattern unit is abc

Rule- The format that the pattern follows
Example: for the pattern 3, 6, 9, 12 the rule is increasing by 3's

Even number- a number that is divisible by 2
Example: 10

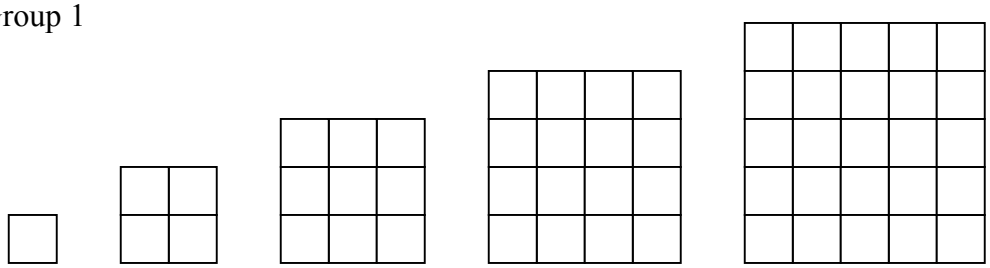
Odd Number- a number than is not divisible by 2
Example: 5

Growing pattern- a pattern that increases or decreases
Example: 12, 10, 8, 6, 4

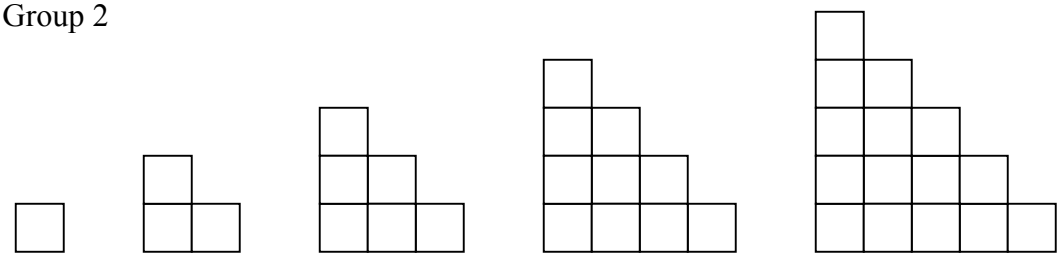
Teacher Resource 2

Day 1 Launch - Patterns for student groups

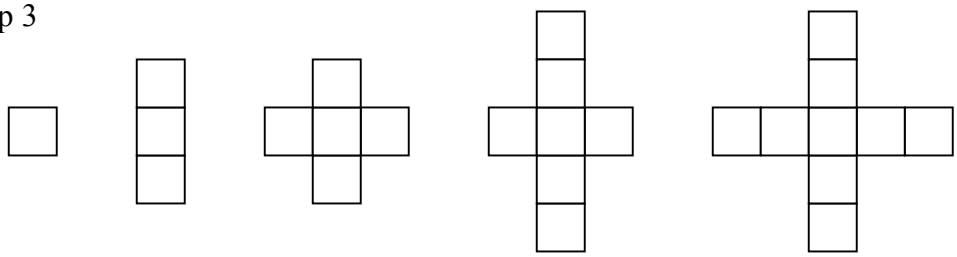
Group 1



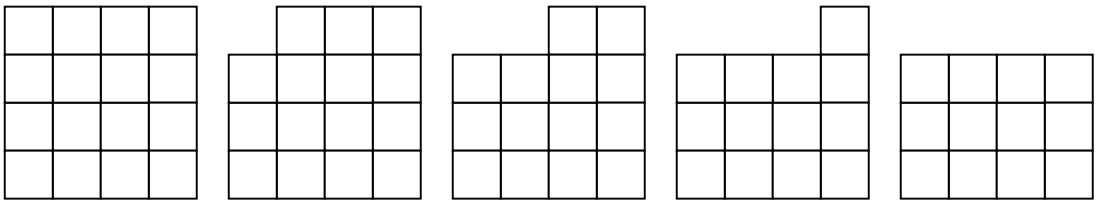
Group 2



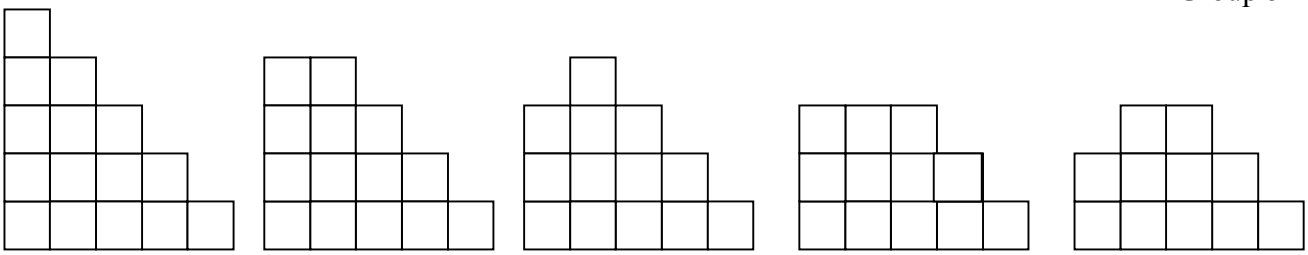
Group 3



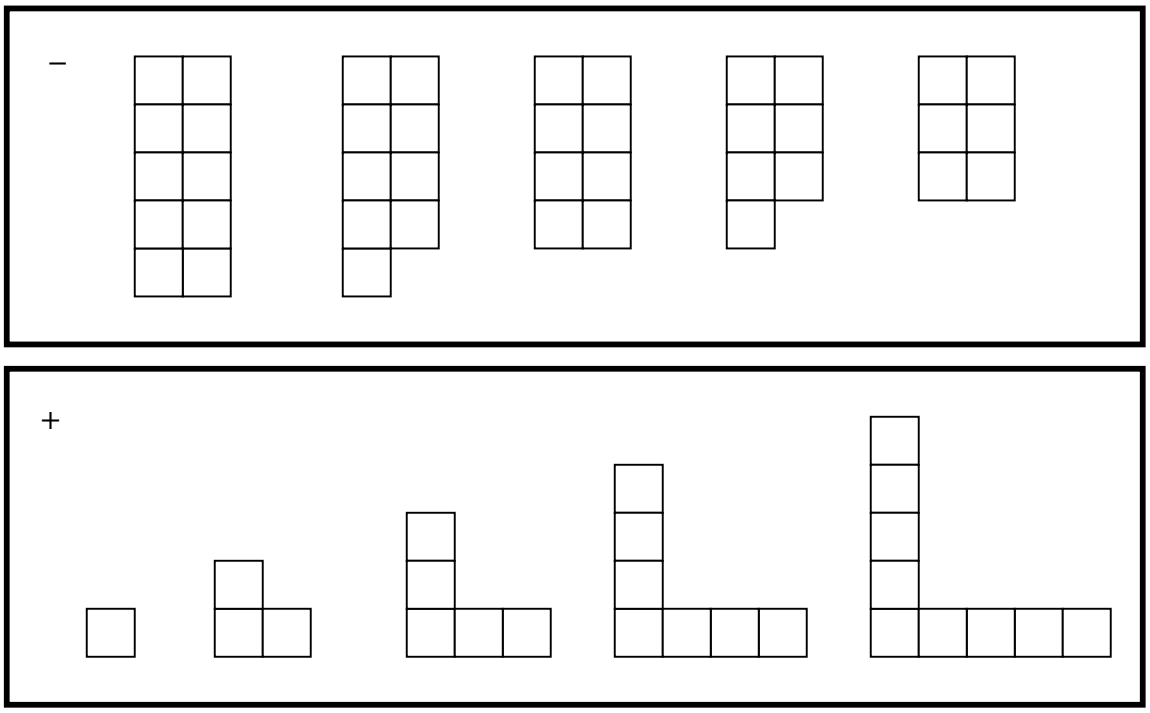
Group 4



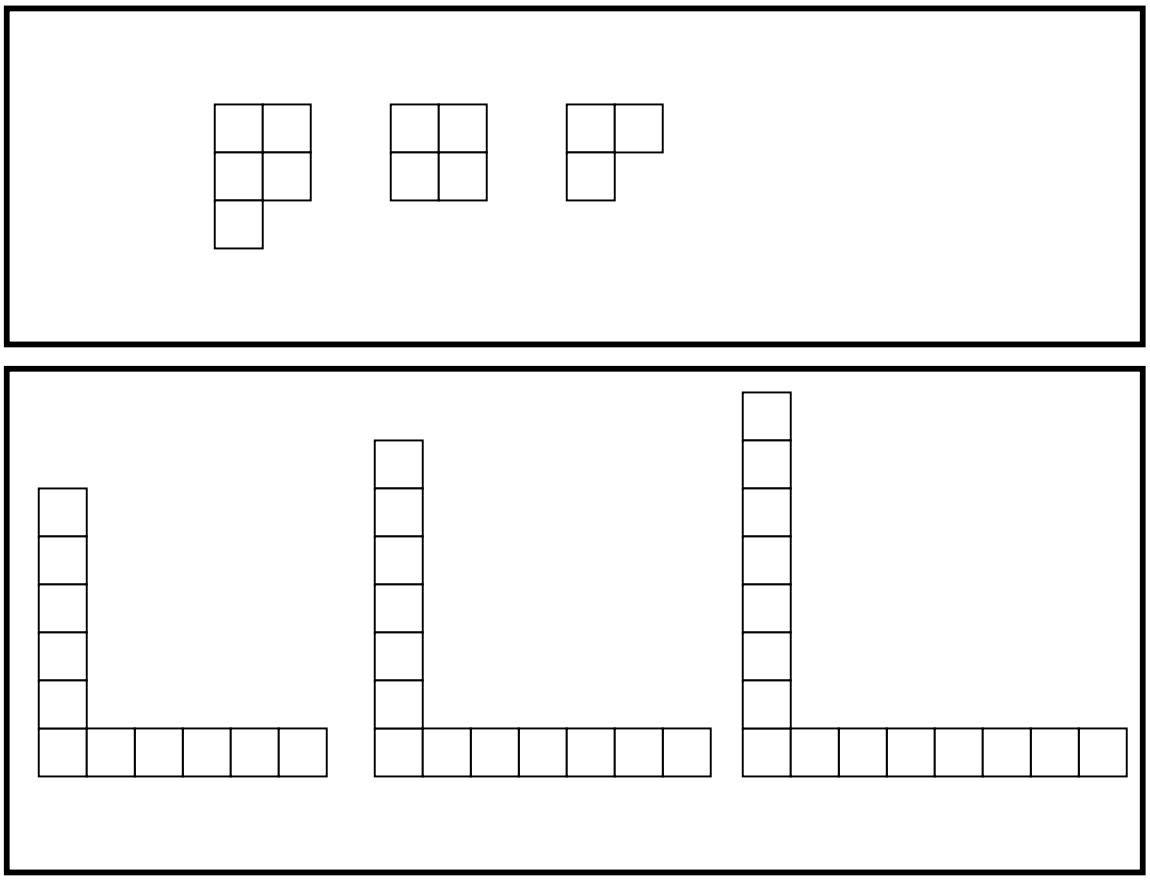
Group 5



Day 1 – Teacher Samples

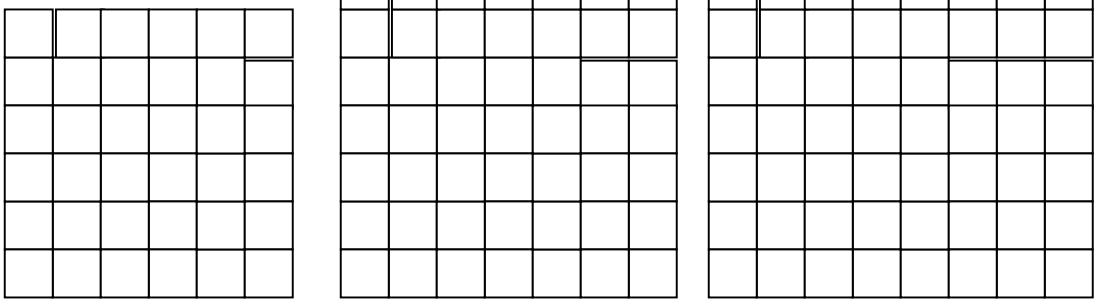


Answer Key – Day 1 Teacher Samples

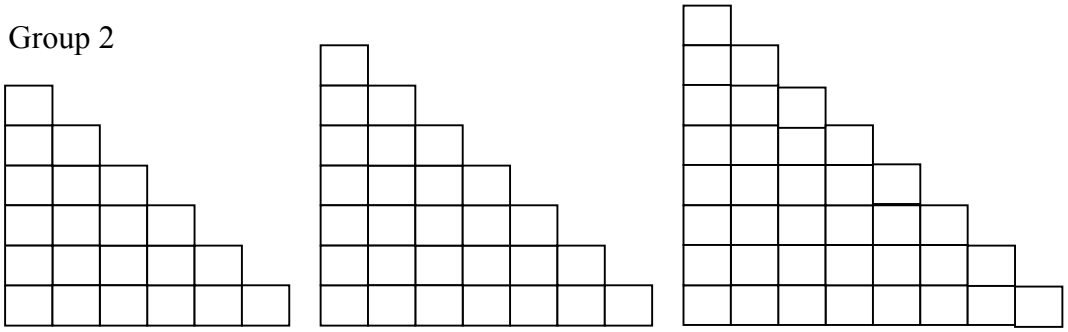


Answer Key – The next 3 terms in each pattern are below:

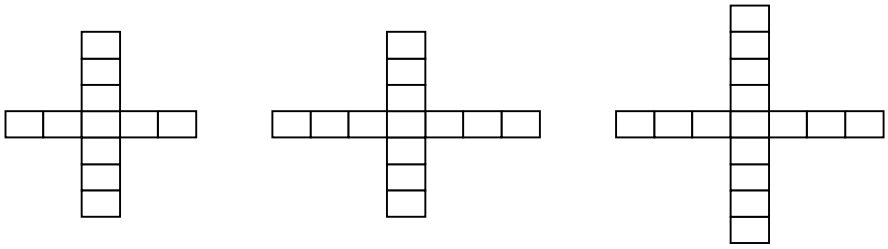
Group 1



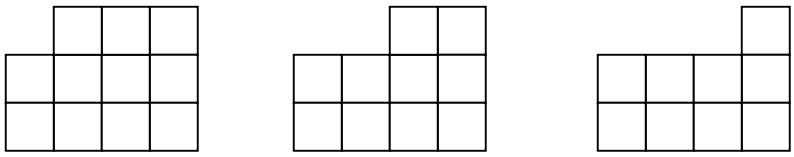
Group 2



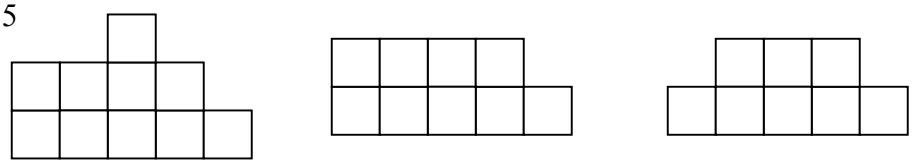
Group 3



Group 4



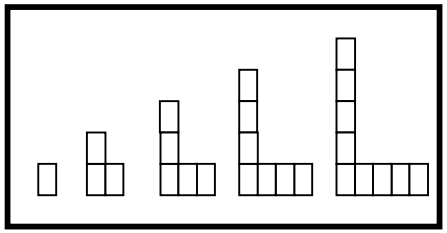
Group 5

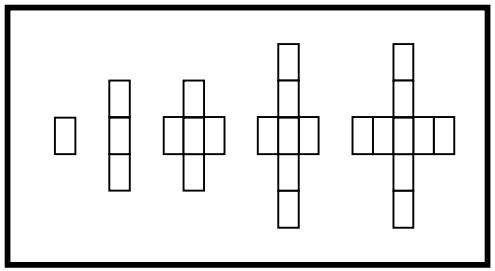


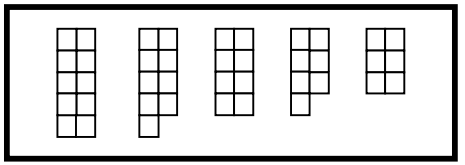
Sample Venn Diagram Day 1

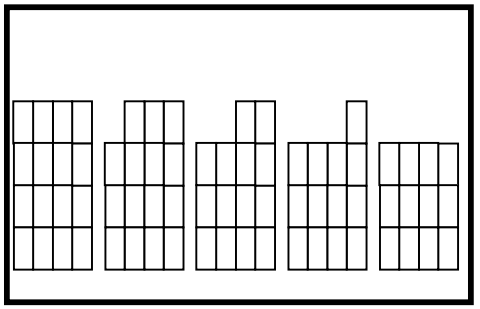
Increasing patterns

Decreasing patterns





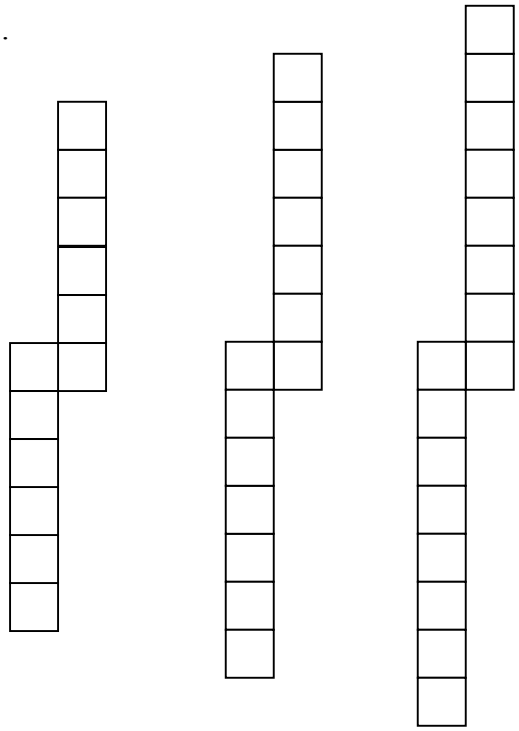




Answer Key for Day 1 Assessment

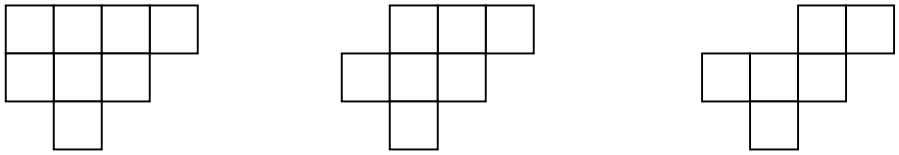
The next 3 terms of each pattern and a description of what is happening are shown below.

1.



One block is added to the bottom left and top right each time.
The pattern is increasing.

2.



The pattern is decreasing. One block is removed from the top row in the direction of left to right each time.

Use this assessment to complete the student checklist.

Student Checklist for Patterns Teacher Resource 8

Student Name: _____

☐ 1. Student can create increasing and decreasing non-numeric patterns.

☐ 2. Student can create increasing and decreasing numeric patterns.

☐ 3. Student can extend decreasing and increasing patterns when given a set of terms.

☐ 4. Student can identify the rule of a growing pattern.

☐ 5. Student can explain a growing pattern using words, numbers and/or pictures.

Comments:

2	4	6
8	10	

5	10	15
20	25	

15	12	9
6	3	

50	40	30
20	10	

125	100	75
50	25	

Answer Sheet

1. Rule: Start at 5 increase by 5
   5, 10, 15, 20, 25

2. Rule: Start at 3 increase by 3
   3, 6, 9, 12, 15

3. Rule: Start at 58 decrease by 2
   58, 56, 54, 52, 50

4. Rule: start at 51 decrease by 3
   51, 48, 45, 42, 39

5. Rule: start at 80 increase by 10
   80, 90, 100, 110, 120

1. Rule: start at 132 and increase or add 2
   132, 134, 136, 138, 140

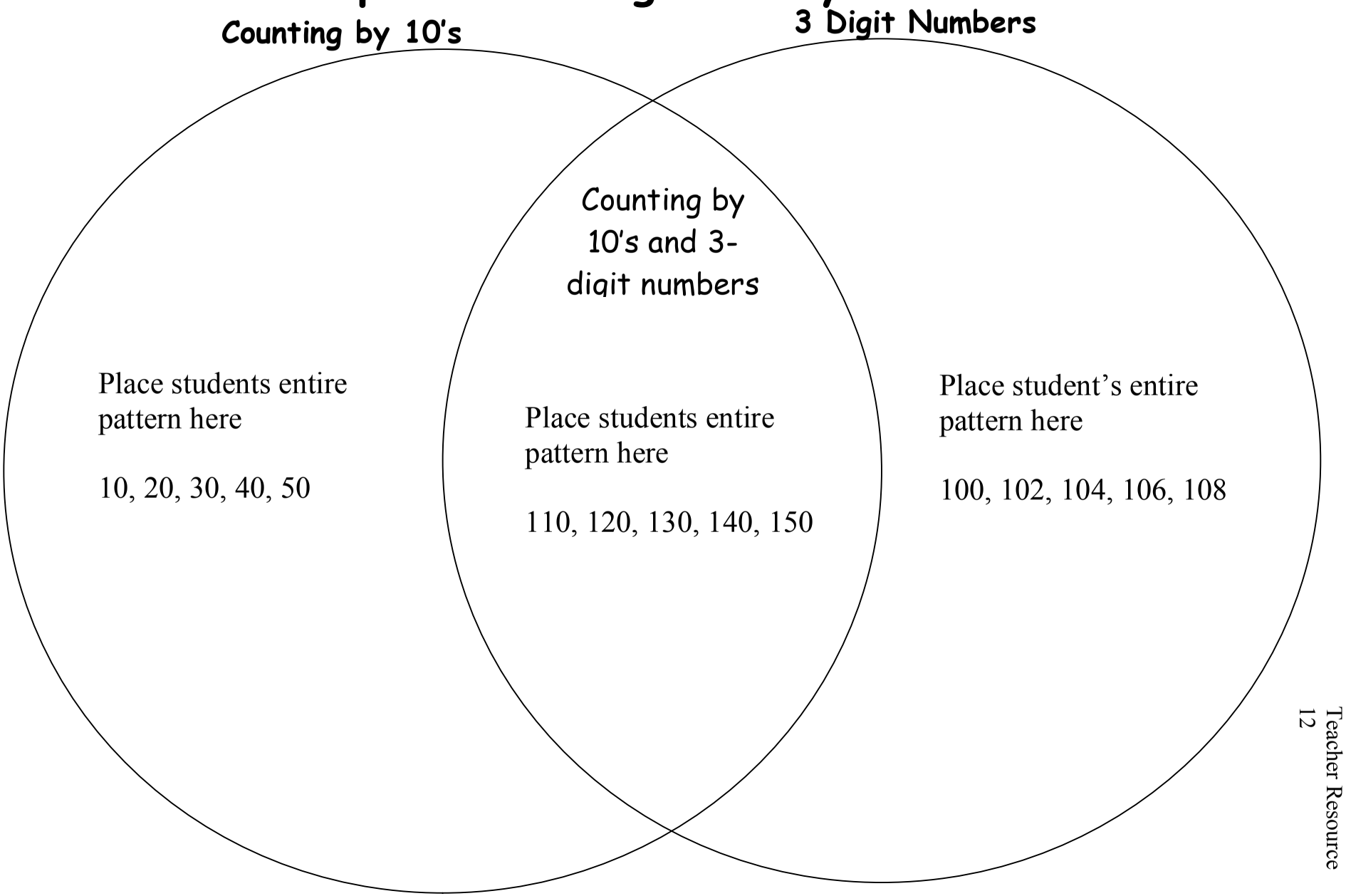
2. Rule: start at 50 and decrease or subtract 5
   50, 45, 40, 35, 30

3. Rule: start at 100 and decrease or subtract by 100
   100, 200, 300, 400, 500

4. Rule: start at 123 increase or add 10
   123, 133, 143, 153, 163

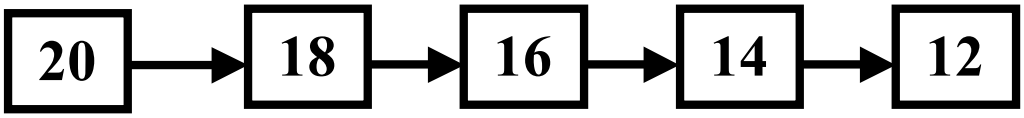
5. Rule: start at 25 increase or add 25
   25, 50, 75, 100, 125

Sample Venn Diagram Day 2

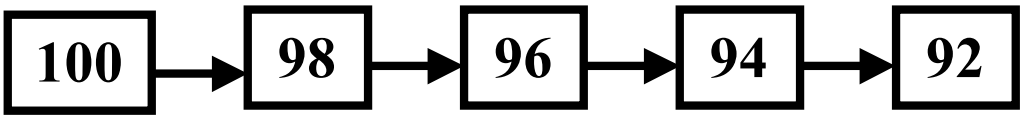


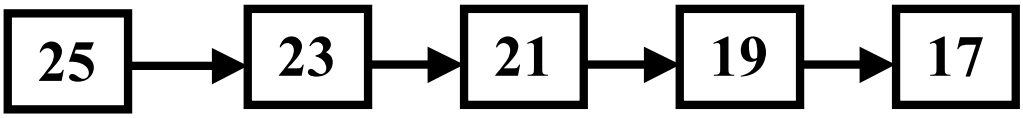
Teacher Sample:

Rule: subtract or decrease by 2



Other patterns with a rule of -2

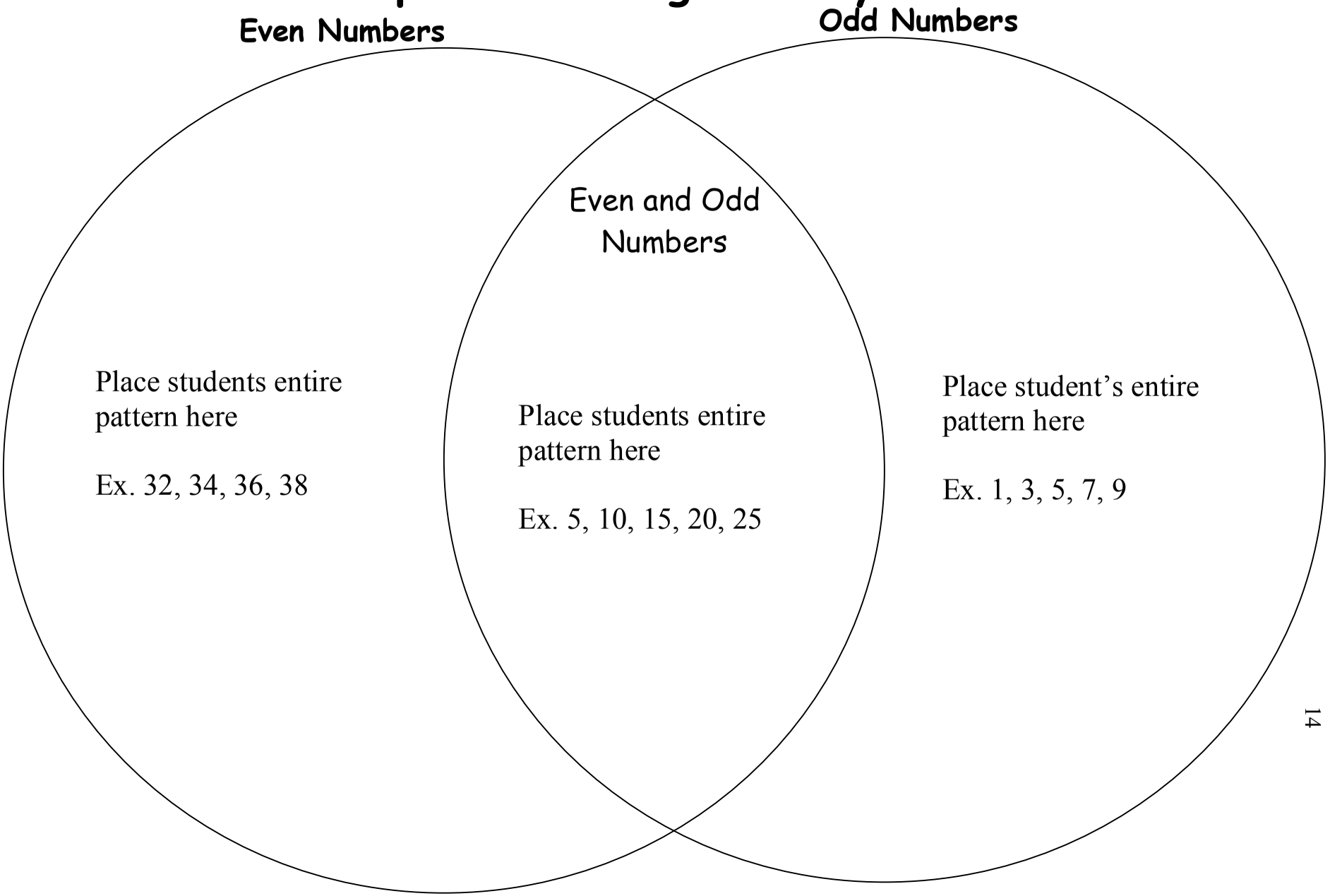




Types of questions to ask:

1. How can you create a pattern with the same rule using even or odd numbers?
2. What similarities do you see in your patterns? What differences do you see?
3. What do you notice about the tens place in your patterns? The hundreds place?
4. Can you create a pattern with the same rule with three digit numbers?
5. When you are counting money, what patterns do you see?

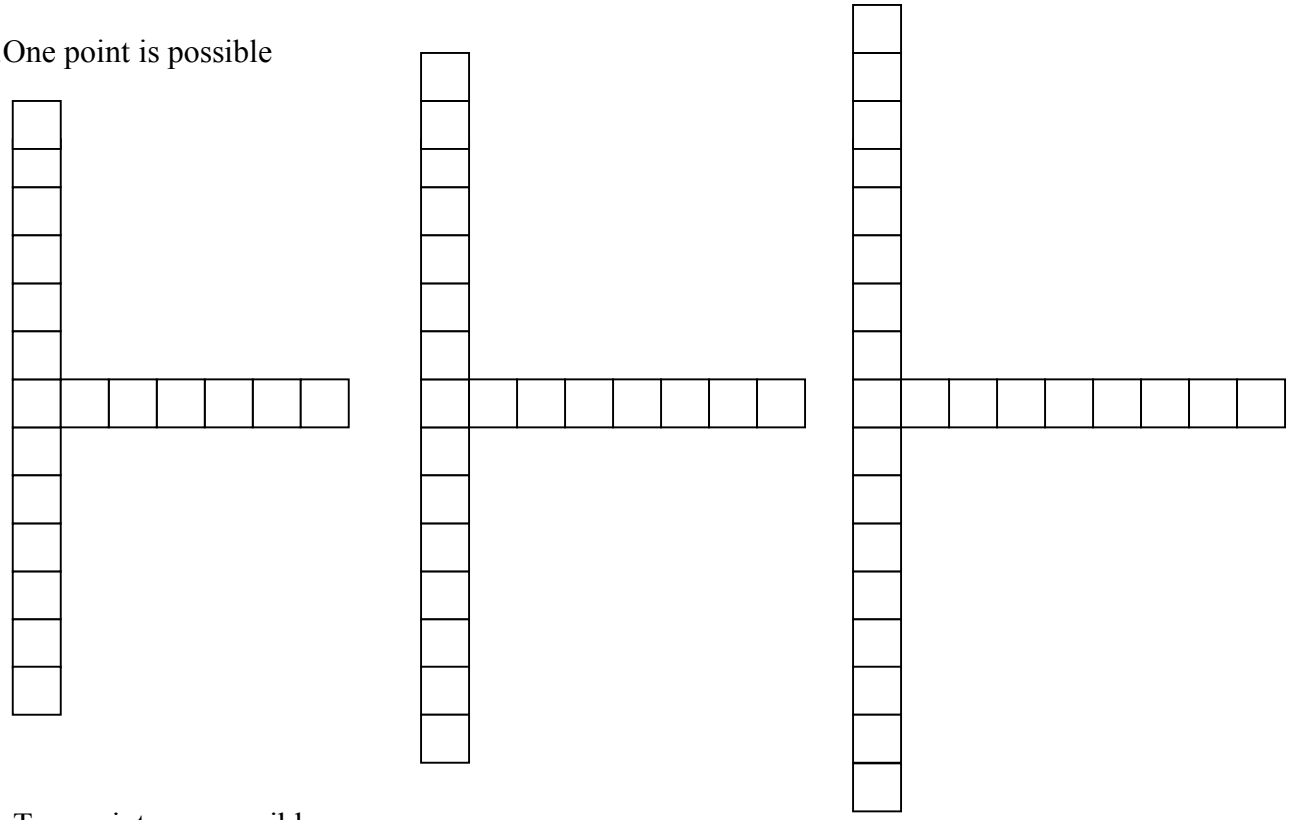
Sample Venn Diagram Day 3



Assessment Answer Key - 14pts total

The next 3 terms in the pattern and the answer to the BCR are below.

1a.One point is possible



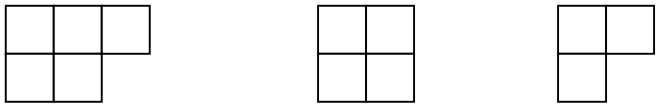
1b. Two points are possible.

2- **Complete understanding -** The pattern is increasing. Once block is added to the top, bottom, and left each time.

1-**Partial understanding -** The pattern is increasing or getting bigger.

0- **Minimal or no understanding -** There are 22 squares in the last one.

2a. One point is possible



2b.

2- **Complete understanding -** The pattern is decreasing. There is one less block in the right column going from bottom to top each time.
1- **Partial Understanding** – The pattern is decreasing or getting smaller each time.
0 – **Minimal or no understanding** – There are 3 blocks in the last one.

3. Sample response: 4, 6, 8, 10, 12 1 point (no credit for adding one: ex. 4, 5, 6)

4. Sample response: 25, 20, 15, 10, 5 1 point (no credit for subtracting one: 5,4,3)

5a. 14, 16, 18 1 point

5b. **Score of 2**: Student gives starting point and describes how the pattern is increasing.
Example: The pattern starts at 8 and is increasing by two.

Score of 1: Student response omits starting point and amount the pattern is increasing by.
Example: The pattern is increasing or getting bigger.

Score of 0: Students adds no additional information as what is happening in the pattern.
Example: 14, 16, 18

6a. 175, 150, 125 1 point

6b. **Score of 2**: Student gives starting point and describes how the pattern is decreasing. Example: Start at 250 and decrease by 25.

Score of 1: Student omits specific decreasing pattern and starting point.
Example: The pattern is getting smaller (decreasing).

Score of 0: Student adds no additional information as to how the answer was given. Example: 175, 150, 125

Teacher Resource 16

MSA Mathematics BCR Rubric

2 The response demonstrates a complete understanding and analysis of a problem.

- Application of a reasonable strategy in the context of the problem is indicated.
- Explanation[1] of and/or justification[2] for the mathematical process (es) used to solve a problem are clear, developed, and logical.
- Connections and/or extensions made within mathematics or outside of mathematics are clear.
- Supportive information and/or numbers are provided as appropriate. [3]

1 The response demonstrates a minimal understanding and analysis of a problem.

- Partial application of a strategy in the context of the problem is indicated.
- Explanation[1] of and/or justification[2] for the mathematical process (as) used to solve a problem is partially developed, logically flawed, or missing.
- Connections and/or extensions made within mathematics or outside of mathematics are partial or overly general, or flawed.
- Supportive information and/or numbers may or may not be provided as appropriate. [3]

0 The response is completely incorrect, irrelevant to the problem, or missing. [4]

Notes:

[1] **Explanation** refers to students' ability to communicate **how** they arrived at the solution for an item using the language of mathematics.

[2] **Justification** refers to students' ability to support the reasoning used to solve a problem, or to demonstrate **why** the solution is correct using mathematical concepts and principles.

[3] Students need to complete rubric criteria for ***explanation, justification, connections*** and/or ***extensions*** as cued for in a given problem.

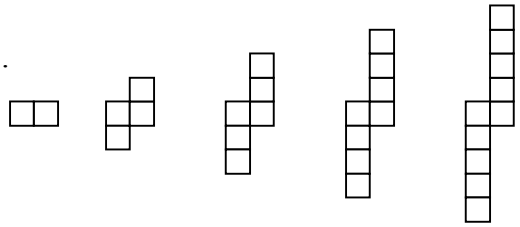
[4] Merely an exact copy or paraphrase of the problem will receive a score of "0".

Day 1 Check-Up Visual Patterns Student Resource 1

Name: _____ Date: _____

Draw or build the next three terms in the pattern. Describe what is happening in the pattern.

1.



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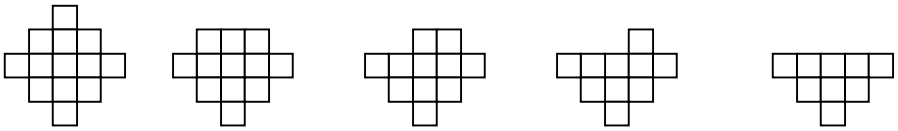
2.



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_____

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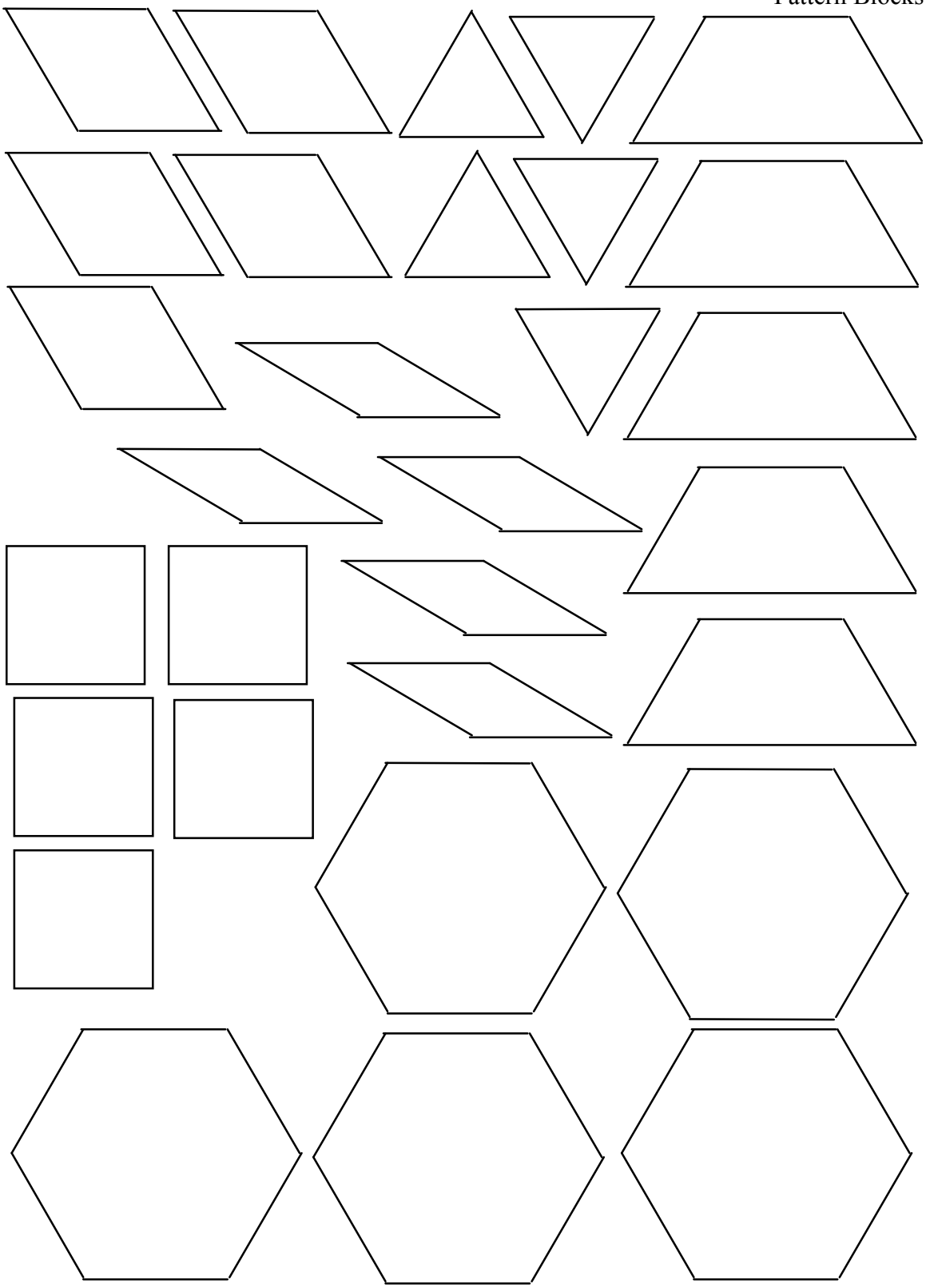
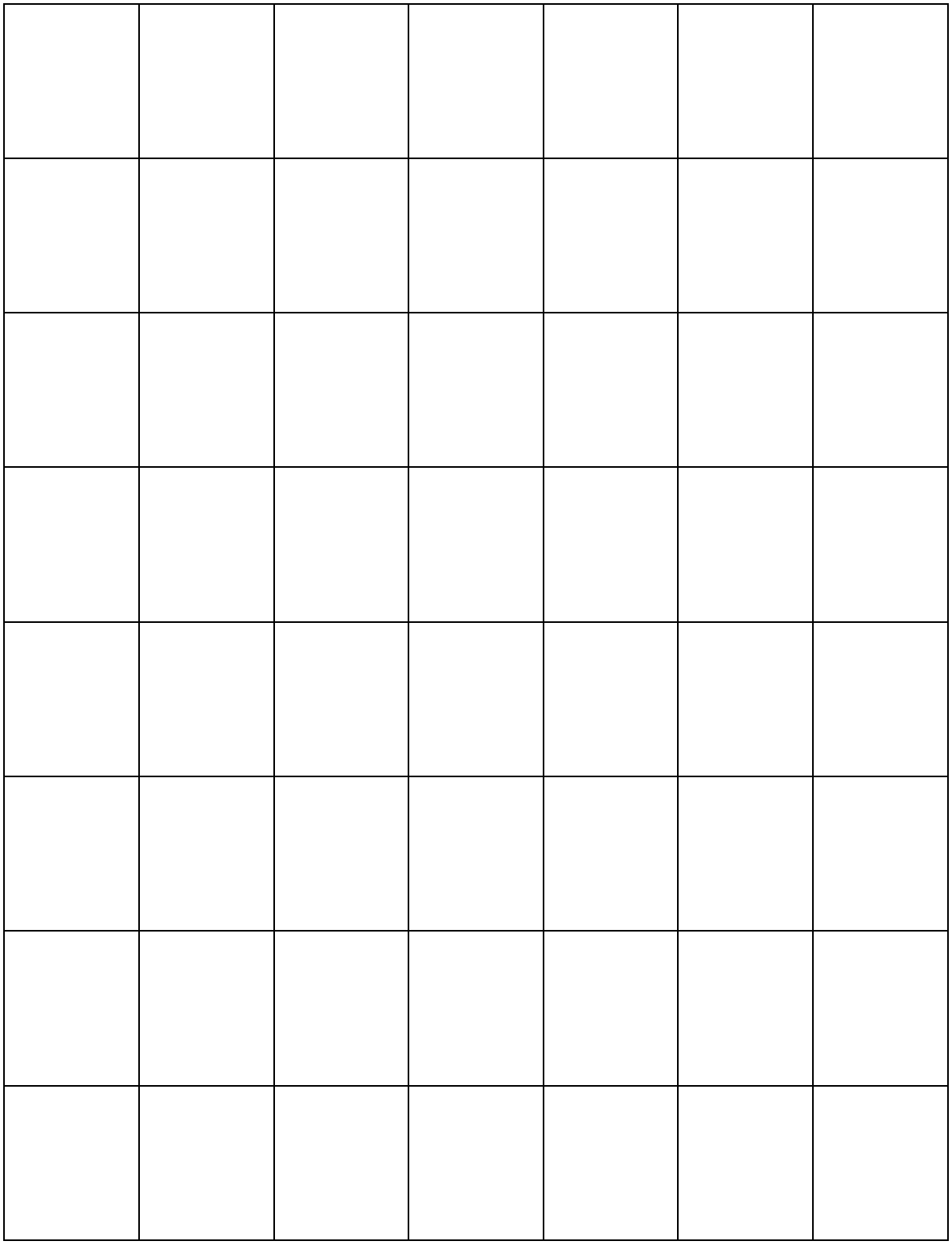
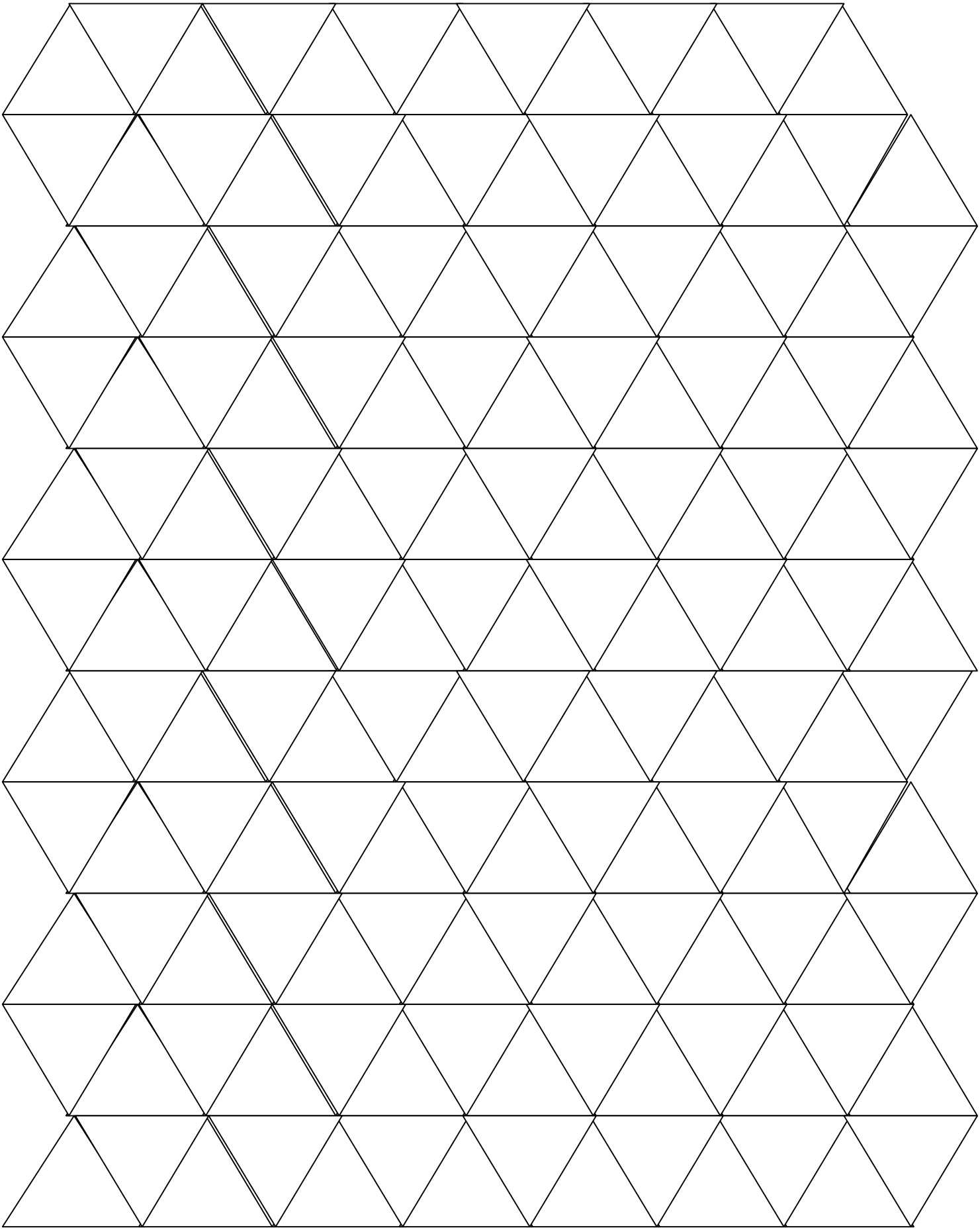
Student Resource 2
Pattern Blocks



Student Resource 3

One Inch Grid Paper





Student Resource 5

Hundred Chart

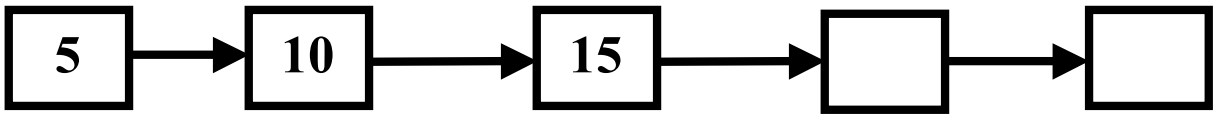
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

200 Chart

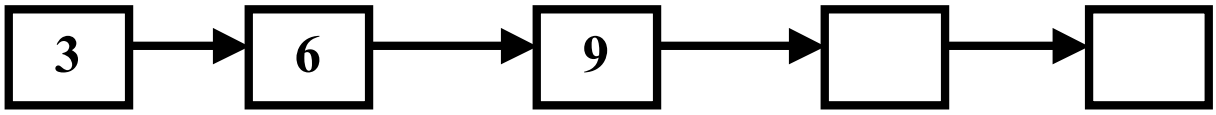
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200

Name _____

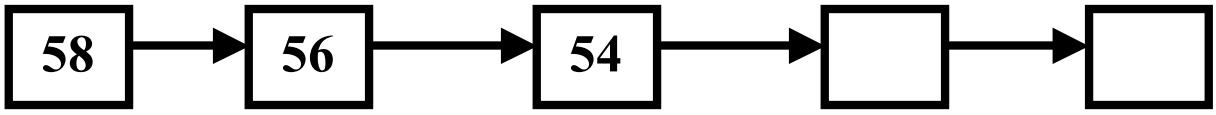
1. Rule: _____



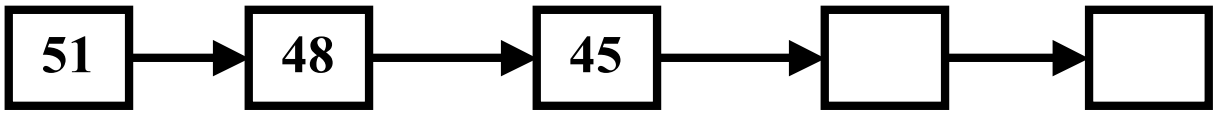
2. Rule: _____



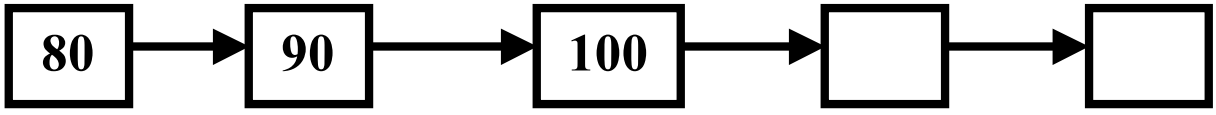
3. Rule: _____



4. Rule: _____

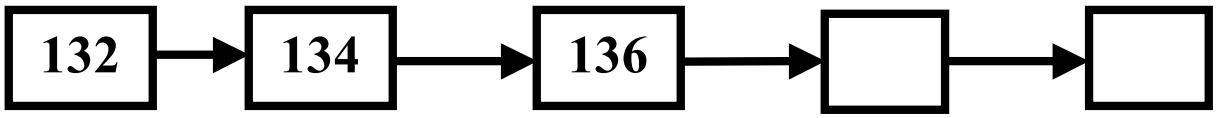


5. Rule: _____

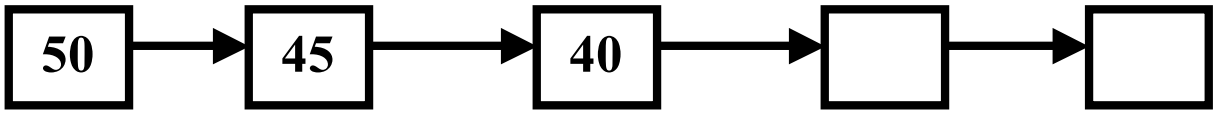


Name _____

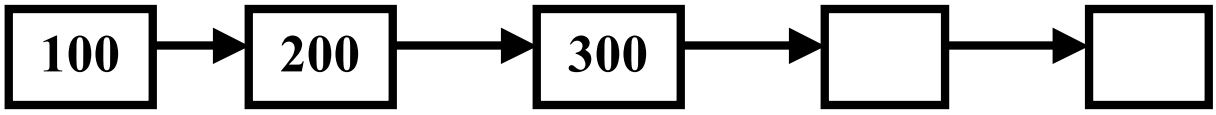
1. Rule: _____



2. Rule: _____

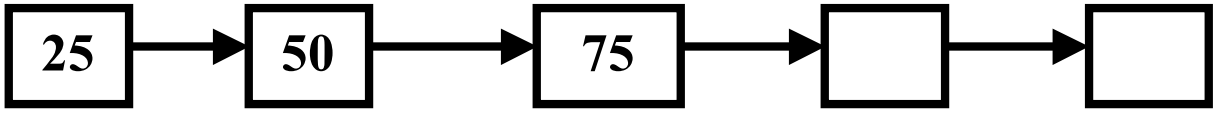


3. Rule: _____



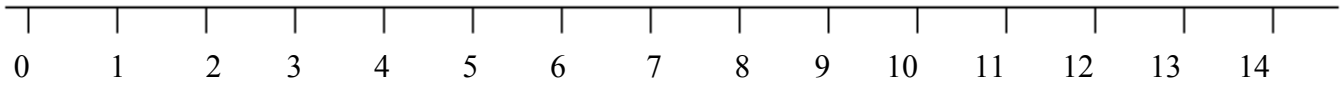
4. Rule: _____

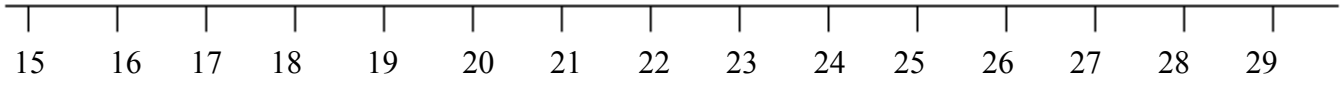
5. Rule: _____

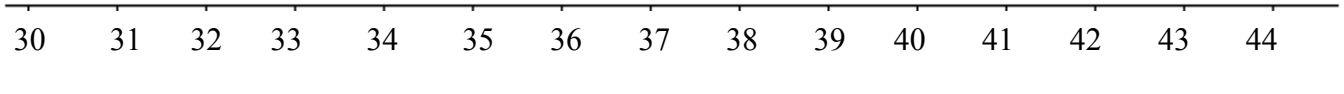


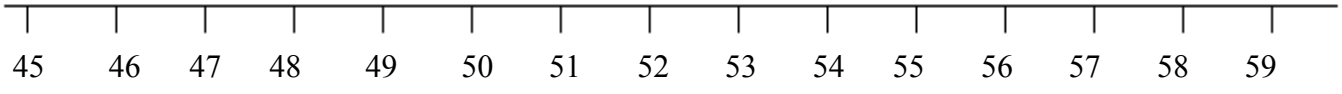
Number Line

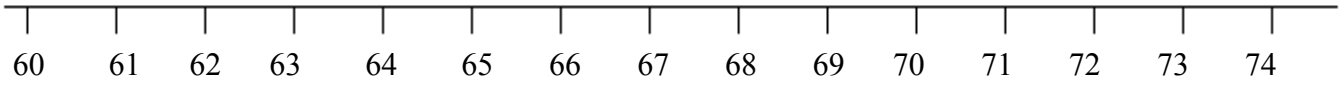
Student Resource 9









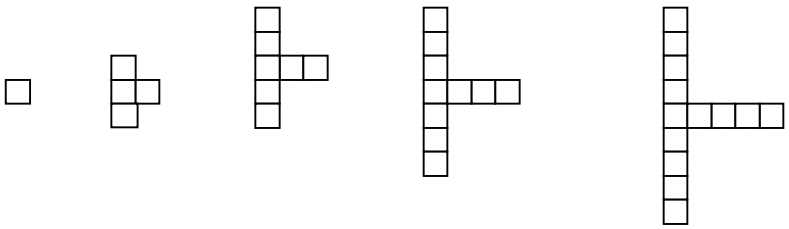


Patterns Final Assessment Student Resource 10

Name: _____ Date: _____

Draw or build the next three terms in the pattern. Answer the BCR about each pattern in the box below.

1a.



1b. Use what you know about patterns to describe what is happening in the pattern above.

_____

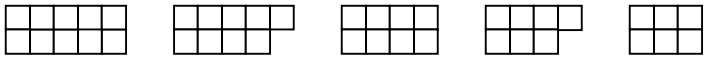
_____

_____

_____

_____

2a



2b. Use what you know about patterns to describe what is happening in the pattern above.

_____

_____

_____

_____

_____

_____

4. Create a decreasing numeric pattern beginning with the number 25.

25, _____, _____, _____, _____

5a. Complete the pattern.

8, 10, 12, _____, _____, _____

5b. Use what you know about patterns to describe how you got your answer. You may use numbers, words, and/or pictures in your answer.

6a. Complete the pattern.

250, 225, 200, _____, _____, _____

6b. Use what you know about patterns to describe your answer. You may use words, numbers or pictures in your answer

Student Resource 11

MSA Brief Constructed Response "Kid Speak" Mathematics Rubric Grades 1 through 8

Score	
2	**My answer shows I completely understood the problem and how to solve it:** • **I used a very good, complete strategy to correctly solve the problem.** • **I used my best math vocabulary to clearly explain what I did to solve the problem. My explanation was complete, well organized and logical.** • **I applied what I know about math to correctly solve the problem.** • **I used numbers, words, symbols or pictures (or a combination of them) to show how I solved the problem.**
1	**My answer shows I understood most of the problem and how to solve it:** • **I used a strategy to find a solution that was partly correct.** • **I used some math vocabulary and most of my reasons were correct to explain how I solved the problem. My explanation needed to be more complete, well organized or logical.** • **I partly applied what I know about math to solve the problem.** • **I tried to use numbers, words, symbols or pictures (or a combination of them) to show how I got my answer, but these may not have been completely correct.**
0	**My answer shows I didn't understand the problem and how to solve it:** • **I wasn't able to use a good strategy to solve the problem.** • **My strategy wasn't related to what was asked.** • **I didn't apply what I know about math to solve the problem.** • **I left the answer blank.**